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ABSTRACT

The purpose of this study was to test the hypothesis that mathematics-related self-efficacy mediates the effects of gender and mathematical preparation and achievement on mathematics-relatedness of college major. The responses of 117 undergraduates to a series of inventories and questionnaires yielded seven variables descriptive of the mathematics-related career-choice process; a causal model of the interrelationships of these variables was constructed from predictions based on self-efficacy theory. A path analysis and consequent refinement of the model resulted in a final path model which was congruent with a self-efficacy approach to women's career development. Gender was found to influence mathematics self-efficacy indirectly through two avenues of influence: (1) socialization influences, as captured by the Bem Sex Role Inventory masculinity score; and (2) mathematics preparation, as mediated by the years of high school mathematics and mathematics achievement level. Mathematics-related self-efficacy in turn influenced both mathematics anxiety and mathematics-relatedness of college major. Gender, years of high school mathematics, and mathematics anxiety were also found to influence mathematics major choice directly, as well as indirectly through mathematics self-efficacy. Unexpected results and implications of the model are discussed. (Author)

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**Mathematics Self-Efficacy and the Consideration
of Math-Related Majors: A
Preliminary Path Model**

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Paper presented at the Annual Meeting of the American Psychological
Association, Los Angeles, August, 1981.

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Abstract

The purpose of the present study was to test the hypothesis that mathematics-related self-efficacy mediates the effects of gender and mathematical preparation and achievement on math-relatedness of college major. The responses of one hundred and seventeen undergraduates to a series of inventories and questionnaires yielded seven variables descriptive of the math-related career-choice process; a causal model of the interrelationships of these variables was constructed from predictions based on self-efficacy theory. A path analysis and consequent refinement of the model resulted in a final path model which was congruent with a self-efficacy approach to women's career development. Gender was found to influence math self-efficacy indirectly through two avenues of influence: 1) socialization influences, as captured by the Bem Sex Role Inventory masculinity score; and 2) mathematics preparation, as mediated by the years of High School mathematics and mathematics achievement level. Math-related self-efficacy in turn influenced both math anxiety and math-relatedness of college major. Gender, years of High School mathematics, and math anxiety were also found to influence math major choice directly, as well as indirectly through math self-efficacy. Unexpected results and implications of the model are discussed.

Mathematics self-efficacy and the
consideration of math-related majors:

A preliminary path model

The increasing realization on the part of counseling psychologists that our knowledge of women's vocational behavior and career development is inadequate (Fitzgerald & Crites, 1980; Osipow, 1973; Vetter, 1978) has been accompanied by a dramatic increase in the empirical literature devoted to this topic. Still missing however, is a synthesizing framework, a relevant theoretical conceptualization of women's career development which is capable of integrating existing knowledge and guiding future research and intervention efforts.

In an attempt to fill this conceptual void, Hackett and Betz (1981) have outlined a self-efficacy approach to women's career development. This approach stresses the role of cognitive-mediational factors, specifically expectations of personal effectiveness or self-efficacy (Bandura, 1977), in career choice, and is already beginning to receive some empirical support. Betz and Hackett (in press), in the first test of the self-efficacy model, reported that career-related efficacy expectations were related to the nature and range of career alternatives being considered by women and men. They also found that gender-related differences in efficacy expectations, particularly lower self-efficacy expectations on the part of women, were strongly predictive of the traditionality of careers under consideration. Several other studies investigating self-efficacy with regard to specific career-relevant behaviors such as professional-level career choice, science career choice, and career decision-making skills, are uncovering a

similar pattern of results; gender differences in career-related self-efficacy exist, and these differences in self-efficacy are predictive of gender differences in the career choice process (see Ayres, Note 1; Kerns, Note 2; Taylor, Note 3).

Self-efficacy with regard to mathematics has been chosen as the topic of investigation in the present study because of the increasing importance of adequate preparation in mathematics to a broad range of career options. Gender differences in mathematics preparation have been termed a "critical filter" in the career development of women and minorities (Sells, 1980); lack of mathematics preparation and consequent lower levels of math achievement result in the premature closure of options, effectively serving to bar women and minorities from higher level, technological, and generally male-dominated occupations (Fox, Brody, & Tobin, 1980). Because of the importance of mathematics to the education and career development of women (Sherman, 1979; Wise, Note 4), it becomes important to examine the role played by mathematics-related self-efficacy expectations in the development of math-related careers.

In any discussion of mathematics-related career choice, the matter of gender differences in mathematics achievement must be addressed. A long-standing controversy still reigns over the possible genetic origins of the often-observed male superiority in mathematics, and in fact this controversy has recently been revived (Benbow & Stanley, 1980). However, there is also strong evidence for the existence of attitudinal and affective differences with regard to mathematics which can account for gender differences in math achievement (Fennema & Sherman, 1977; 1978; Sherman & Fennema,

1977). Furthermore, the finding of sex-typing of mathematics as a male domain on the part of male and female students (Fennema & Sherman, 1978) further supports the notion that sex-role socialization plays a major role in mathematics-related behavior. However, the effects of sex-role socialization on math achievement do not appear to be direct; that is, sex role influences work through other factors such as attitudes towards mathematics or election of math courses in High School (Sherman & Fennema, 1977).

Several studies uncovered a strong relationship between the nature and number of mathematics courses in High School and gender differences in math achievement (Fennema & Sherman, 1977; Hendel, 1980; Wise, Note 4). Fennema (1980) reported that, when mathematics background was controlled for, something which few studies on gender differences in mathematics have done, few gender-related math achievement differences have been found. Furthermore, the most important predictors of mathematics achievement, persistence in math courses, and election of future courses in mathematics, when math preparation is controlled for, are attitudes towards mathematics (Pedko, Wolleat, Fennema, & Becker, 1981; Sherman & Fennema, 1977).

The affective and attitudinal variables which have been discovered to predict mathematics-related behavior include confidence in learning mathematics, math anxiety, and the perceived usefulness of mathematics. What Fennema and Sherman (1976) call "Confidence in learning mathematics" is somewhat similar to, yet distinct from mathematics self-efficacy. Confidence in learning mathematics is a rather global estimate of how well one expects they can do, or has done, in math courses in general. Mathematics self-efficacy is a more specific estimate of confidence in

one's ability to perform well with regard to particular mathematical tasks, or in particular math and math-related courses. However, the evidence supporting the relationship of Confidence in learning mathematics to math performance (Fennema & Sherman, 1977; 1978), and the finding that men consistently score higher on the Fennema-Sherman Math Confidence Scale (Fennema & Sherman, 1977), is suggestive of the importance of mathematics-related self-efficacy to the prediction of math-related career choice.

Findings with regard to the effects of perceptions of the usefulness of mathematics on math achievement are inconsistent, but the relationship of math anxiety to math-related performance and career choice is undeniable (Fennema, 1980). The results of studies by Betz (1978) and Hendel (1980) on very different populations were similar in that math anxiety was found to be strongly related to math performance. Based on her research, Fennema (1980) has stated that math confidence and math anxiety are highly interdependent, a conclusion in keeping with the self-efficacy model, and in fact, Hendel found self-estimated math ability to be highly correlated with math anxiety, and also strongly related to math performance.

Finally, Goldman and Hewitt (1976) convincingly demonstrated the influence of mathematics performance, as measured by the mathematics score of the Scholastic Aptitude Test (SAT), on math-related major choices in college. Their findings are helpful in explaining why fewer women major in mathematics and the sciences, and provide further evidence for the connection between math background, performance, and attitudes, and math-related major and career choices.

Although much is known about the variables which are thought to in-

fluence math achievement and math career choice, the documented correlations among these variables do not allow strong statements about the causal relationships underlying them. Goldman and Hewitt (1976) and Hendel (1980) have suggested that prior performance and achievement are the factors which are influenced by gender and consequently directly influence math-related major and career choices. Self-efficacy theory (Bandura, 1977; Hackett & Betz, 1981) would predict that mathematics-related self-efficacy, as influenced by gender, socialization, and math level and background, is more strongly predictive of math major and career choice than ability, math background, or gender alone or in combination. Math anxiety, according to the self-efficacy approach, is viewed as a consequence of efficacy expectations with regard to mathematics, and is therefore a joint predictor, along with math self-efficacy, of math-related career choice.

The purpose of the present study then, is the development and refinement of a causal model of math-related major/career choice utilizing math self-efficacy as a major mediating variable. The original model was constructed according to predictions made on the basis of the self-efficacy approach to career development (Hackett & Betz, 1981), tested for its explanatory adequacy, and revised. Specifically, this investigation was concerned with assessing the usefulness of the concept of mathematics self-efficacy in the prediction of math-related major choice.

METHOD

The development of the path model described in this paper was based on data collected as a part of a larger project on mathematics self-efficacy and math-related career choice. The discussion which follows has been abbreviated; only those components of the larger project which

are directly relevant to the path analysis will be discussed in depth.¹

Instruments

Mathematics Self-Efficacy Scale. For the purposes of instrument development, mathematics self-efficacy was defined as expectations of one's ability to perform well in the following three areas: 1) everyday math tasks; 2) mathematics problems; and 3) math-related courses.

In order to measure self-efficacy with regard to the kinds of math tasks or situations encountered in the course of everyday activities, 30 items from the Mathematics Anxiety Rating Scale (MARS; Richardson & Suinn, 1972) were selected. The Mathematics Confidence Scale (Dowling, Note 5), an 18-item instrument assessing the degree of confidence in one's ability to successfully solve a series of arithmetic, algebra, and geometry problems, was incorporated into the Mathematics Self-Efficacy scale in order to tap the second dimension of self-efficacy, that is, math problems. Finally, a series of 27 courses, reflecting all 5 levels of Goldman and Hewitt's (1976) math-science continuum, as well as both traditionally-male (nontraditional for females) and traditionally-female content areas, were selected to assess self-efficacy with respect to math-related courses.

For the course subscale, Ss were instructed to rate their confidence in their ability to complete each course with a grade of "B" or better. For the math tasks and math problems subscales, Ss simply rated their confidence in their ability to successfully perform the task or solve the problem. Confidence ratings for all scales were elicited on a 10-point continuum from "No confidence at all" (0) to "Complete confidence" (9).

Mean subscale scores and the total self-efficacy score were obtained by summing the confidence ratings over all items and dividing the total by the number of items which were responded to. The course subscale was further subdivided into mean scores for the traditional and nontraditional (for females) courses.

A pilot study was conducted in order to refine the math self-efficacy scale and to obtain reliability data on the scale. Based on an $N=115$, the internal consistency for the math tasks, math problems, and math courses subscales of the math self-efficacy scale were $\alpha=.92$, $.96$, and $.92$, respectively. The reliability of the entire scale was $\alpha=.96$. Item-total correlations as well as individual item distributions were examined in order to identify and eliminate highly redundant and highly inconsistent items.

The revised math self-efficacy scale contained 52 items: 18 items on the math tasks subscale, 18 items on the math problems subscale, and 22 items on the math courses subscale, 6 of which were traditional courses, 16 of which were nontraditional courses. The internal consistency reliability for the revised scale, computed on data from 262 Ss, was $\alpha=.96$; for the subscales the breakdown was $\alpha=.90$ for math tasks, $\alpha=.92$ for math problems, and $\alpha=.93$ for math courses. The total math-related self-efficacy score employed in the path analysis was computed slightly differently than in the pilot study. Self-efficacy with regard to traditional courses was excluded from the computation of total math self-efficacy because these scores did not reflect the definition of math self-efficacy outlined above. Sex-role stereotyping of these courses had a greater influence on responses than did the math content of the courses.

Fennema-Sherman Mathematics Attitude Scales. Five of the nine Mathematics Attitude Scales (Fennema & Sherman, 1976), Confidence in Learning Mathematics, Usefulness of Mathematics, Mathematics as a Male Domain, Effectance Motivation in Mathematics, and the slightly revised version of the Math Anxiety scale, as modified by Betz (1978) in order to be more appropriate for college students, were administered. However, only the scores from the revised math anxiety scale were employed in developing and testing the path model.

Responses on the Math Anxiety scale were scored on a 5-point Likert-type scale from 1 (strongly disagree) to 5 (strongly agree). Half of the items were negatively worded and half were positively worded; those which were negatively worded were reverse-scored and item scores added to obtain the overall Math Anxiety score. High scores on the math anxiety scale are indicative of low levels of math anxiety, whereas low scores on this scale indicate higher levels of math anxiety. The split-half reliability of the revised math anxiety scale was .92 (Betz, 1978).

Background Questionnaire. A series of questions were added to the math attitude scales in order to gather a range of demographic information as well as information relative to mathematics preparation and career plans. Three variables relevant to the path analysis were elicited from each student: gender, years of high school mathematics, and the student's declared major, if they had declared a major. The majors were then rated according to Goldman and Hewitt's (1976) science/math continuum, from the fine arts (1) to the physical sciences and mathematics (5), in order to obtain an index of the math-relatedness of the major choice. Gender was transformed into a dummy variable for the regression equations with females coded "1" and

males coded "0".

Bem Sex-Role Inventory (BSRI). The mean masculinity scale score from the BSRI was employed in this investigation as an index of the effects of sex-role stereotyping (Bem, 1974). The BSRI consists of 60 adjectives for which respondents are asked to rate themselves according to a seven-point scale from "Never or almost never true" (1) to "Always or almost always true" (7). The masculine subscale is composed of 20 adjectives which have been judged as more socially desirable for men in our culture.

Participants and Procedure

The original 262 Ss who participated in the study (153 females; 109 males) were undergraduate volunteers enrolled in introductory psychology courses who received course credit for their participation. Because introductory psychology is required as a part of the basic educational requirements for most major fields, participants represented a wide variety of academic majors.

The order of administration of the two math questionnaires was randomly assigned to small groups of Ss, while the BSRI was always administered last. Mathematics-scale scores from the American College Test (ACT) were obtained from university records for 70% of the Ss.

One hundred seventeen Ss (45 males; 72 females) or 45% of the original subject pool were ultimately selected for inclusion in the path analysis. Reduction in the sample size resulted from missing data; ACT scores were unavailable for 30% of the sample and only 69% of the Ss had declared a major. Examination of the means and standard deviations from the full and reduced sample revealed a surprisingly close correspondence between these sets of scores, and promoted confidence in the representativeness of the subject sample employed in the path analysis.

Data Analysis

Path analysis was chosen as the most appropriate procedure for examining the possible causal relationships among the variables identified as having an effect on math-related major choice. Causal modeling in general, and path analytic techniques in particular, have been developed to examine and test causal relationships in non-experimental research (Asher, 1976; Blalock, 1964; Meise, 1975). This approach to the analysis of correlational data has not been used extensively in psychological and educational research, but its potential applicability to these fields is beginning to be acknowledged (Leclair, 1981).

Causal modeling is especially appropriate with regard to research in the area of gender-related differences in mathematical ability because of the consistent identification in the literature of several variables correlated with math ability, and the clear consequences of the observed differences in math ability for the career choice process. In other words, gender and socialization influences, amount of High School mathematics, level of math achievement, math anxiety, and confidence in learning math are clearly related in some way to math major/career choice. Path analytic techniques allow us to move beyond simple or multiple correlations to testing the causal ordering of these variables that is hypothesized on the basis of self-efficacy theory. Specifically, gender is hypothesized to influence all other variables directly and indirectly; sex-role socialization, as measured by the BSRI masculinity scale mediates some of the influence of gender, and in turn affects years of high school mathematics courses taken, ACT math scores, and finally math self-efficacy. Math

self-efficacy is hypothesized to mediate these causally-prior influences, and consequently affect math anxiety and math-related major choice.

RESULTS

Zero-order correlations were obtained for all variables included in the analysis, and these correlations, along with the respective means and standard deviations for each variable, are presented in Table 1.

Insert Table 1 about here

Correlations between all variables included in the model, except for the masculinity score, were significant in relation to the math/science relatedness of major choice; self-efficacy was the variable most highly correlated with math-related major choice, with $r=.50$ ($p<.001$). The Math ACT score, math anxiety, and years of High School mathematics demonstrated the highest correlations with math self-efficacy ($r=.66$, $.58$, and $.47$, respectively), although correlation coefficients between math self-efficacy and the remaining variables achieved statistical significance as well.

Masculinity scores bear the lowest direct relationships to the variables in the path model: significant correlations were only found between masculinity and self-efficacy and gender ($r=.26$ and $-.28$), indicating that males tended to score higher on the BSRI masculinity scale, and that higher masculinity scores were related to higher levels of math self-efficacy.

The correlation between ACT Math scores and years of high school math was statistically significant at $p=.001$ ($r=.46$), but both scores were also strongly correlated with math self-efficacy and math anxiety.

In order to test the hypothesized causal ordering of these variables, path coefficients were estimated via a series of multiple regressions. Each endogenous variable in the model was regressed on all causally-prior variables, and beta (standardized regression) coefficients were examined (Asher, 1976). All path estimates $< .10$ were excluded from the model, and the regression analyses were performed again on the reduced model. These analyses are presented in Table 2, along with the breakdown of the causal effects, and the R^2 from the Full and Reduced models. The decomposition of causal effects is a means for determining the "true" versus the "spurious", or unexplained covariance. As can be seen from Table 2, the reduced model explained almost as much of the variance as the full model for all regression equations.

Insert Table 2 about here

While a large amount of unexplained variance exists in the prediction equations for masculine sex-role and years of high school mathematics, later equations yielded a moderate to high R^2 for the reduced path model. Evidently, some exogenous variables which have not been incorporated into the model are contributing to the variability in the prediction of masculine sex-role orientation and years of high school mathematics scores.

Gender and years of high school mathematics adequately predict Math ACT scores; and ACT math, years of high school math, and masculine scores, in combination, explain a great deal of the variability in math self-efficacy ($R^2 = .54$). These data support the contention that amount of high school math preparation influences self-efficacy directly, but also in-

directly, i.e., through math achievement, as measured by Math ACTs.

There appear to be two separate paths of influence from gender to math self-efficacy: The first path, through masculinity, might be termed "direct socialization influences;" the second, or indirect influence of socialization, reflects math preparation and achievement. Gender did not influence math self-efficacy directly.

A moderate amount of the variability in math anxiety scores was accounted for by gender, masculine sex role, and math self-efficacy ($R^2=.37$), although the direct effects of masculinity scale scores on math anxiety were contrary to expectations. The coefficient for the masculinity/math anxiety path was $-.17$, indicating that low masculinity scores were related to lower levels of math anxiety (high scores on the Fennema-Sherman Math Anxiety Scale). Yet the indirect effects of masculinity on math anxiety, as mediated by math self-efficacy, are positive; that is, higher masculinity scores are related to lower levels of math anxiety. The zero-order correlation between masculinity and math anxiety is statistically nonsignificant ($r=.02$).

Finally, the science/math-relatedness of college major choice is predicted directly by gender, years of high school mathematics, math self-efficacy, and math anxiety ($R^2=.38$). It is clear from the decomposition of the causal effects that gender, years of high school math, and math self-efficacy have indirect as well as direct effects on major choice. The relatively high degree of covariation between math anxiety and major choice which is left unaccounted for by the model leads to the suspicion that math anxiety may have indirect effects on major choice as well;

these indirect influences could be transmitted by another variable which ought to be included in the model or, perhaps, transmitted via a reciprocal linkage between math anxiety and math self-efficacy.

Figure 1 presents the reduced path model with all significant path coefficients, along with path coefficients for the residual variables. The residual variables represent the effects of variables not included in the model; the path coefficients for these effects have been calculated according to the formula $\sqrt{1-R^2}$. The multiple R for each coefficient is derived from the multiple regression on each endogenous variable, and the corresponding R^2 represents the residual variance from each equation.

Insert Figure 1 About Here

DISCUSSION

The hypothesized causal ordering of the variables correlated with mathematics achievement was supported by the results of the current investigation. Gender-related socialization influences in combination with amount of mathematics preparation predict level of mathematics achievement which is, in turn, predictive of mathematics-related self-efficacy. Math self-efficacy, as influenced by these causally-prior variables, is consequently predictive of both math anxiety and math-related major choices. The correlational data are very similar to the findings of previous research on math achievement (Fennema & Sherman, 1977; 1978; Sherman, 1979; Sherman & Fennema, 1977); the path analysis supports the central

mediational role of mathematics self-efficacy in the development of math-related careers.

Unexpected results emerging from the study point to several deficiencies in the proposed path model. Obviously, gender alone is insufficient to explain mathematics-related behavior in High School. The relatively low proportion of the variance of the first several variables accounted for suggests the existence of at least one, if not several, exogenous variables which should be added in order to increase the model's explanatory capability and predictive power. For example, socioeconomic status (Wise, Note 4), parental background and attitudes (Fennema & Sherman, 1977), and the influences of teachers and school systems (Fennema & Sherman, 1977; 1978) all may affect mathematics-related attitudes and behaviors in High School.

Another interesting outcome of the study was the failure of the BSRI masculinity score to significantly contribute to the prediction of years of High School mathematics courses or Math ACT scores. Gender-related differences in mathematics preparation and achievement were expected to be mediated by the masculinity scale score, an index of the extent of sex-role socialization. That is, gender was thought to affect math preparation and achievement indirectly, via masculine sex-role orientation. This evidently is not the case.

While the results with regard to the masculinity scores may very well be valid, there is always the possibility that they may be an artifact of the instrumentation or design of the study. There is no generally satisfactory instrument for the assessment of the effects of sex-role social-

ization. Theoretical and psychometric problems with the concept of androgyny and sex-role orientation abound and the BSRI, in particular, has been heartily criticized (Locksley & Colten, 1979; Pedhazur & Tetenbaum, 1979). Furthermore, the BSRI was developed to categorize respondents into a fourfold sex-role classification through the use of both feminine and masculine scale scores. The employment of the masculine scale alone, necessitated because the path analysis required interval data, may account for the problematic findings.

The suspicion that the BSRI masculinity score was not an appropriate measure of sex-role socialization was reinforced by the finding that masculinity scores were unrelated to math anxiety when a simple correlation was computed, yet masculinity contributed significantly but negatively to the regression equation predicting math anxiety (path coefficient = -.17). This puzzling finding may also be due to sampling error. Replication of this path analysis with a larger sample is currently underway.

Finally, the proposed model does a good job of predicting math-relatedness of college major, accounting for a hefty 38% of the variance. However, as discussed in the results section, there is also a great deal of covariation not accounted for by the model, especially with regard to the math anxiety variable. Evidently, math anxiety influences math-relatedness of major choice indirectly as well as directly, and the indirect influence, which is not depicted in the model, must be mediated by some other variable, possibly math self-efficacy. Alternately, math anxiety may not be a unique contributor to math-related major choice. Rounds and Hendel (1980) have suggested that math anxiety is actually

nothing more than a reflection of various other factors such as mathematics background and test anxiety. This hypothesis warrants further empirical scrutiny.

The above findings highlight one of the major problems with the analysis, that is, that the model is static and only captures to a limited degree the processes underlying the development of math-related competencies and attitudes. Self-efficacy theory suggests an ongoing and reciprocal interaction between mathematics-related efficacy expectations and math anxiety, mathematics achievement, and math-related major and career choice (Hackett & Betz, 1981). Therefore, nonrecursive models incorporating these hypothesized reciprocal linkages must be developed and tested, and studies of a longitudinal nature need to be conducted in order to build a model which will come closer to reflecting the process of career development and mathematics-related career choice.

In conclusion, the present investigation yielded results very similar to the results of other research on the self-efficacy approach to women's career development (Ayres, Note 1; Betz & Hackett, in press; Kerns, Note 2; Taylor, Note 3). The implications for counselors are clear: counselors working with clients with career concerns, especially female clients with career concerns, must work not only with the interests, values, and abilities of each client, but also with the individual's perceptions of their abilities and perceptions of the gender-appropriateness of the options that may be available to them.

Math-related majors and careers are often viewed as inappropriate or less appropriate for women. Signs that these stereotypes are breaking

down exist, but there remain the subtle and indirect effects of sex-role socialization, that is, lack of confidence or low self-efficacy with regard to mathematics, which may still effectively serve to hold women back from the pursuit of these traditionally-male dominated and generally higher level occupations. Therefore, counselors and educators must actively work to bolster women's career and math-related self-efficacy expectations if dramatic shifts towards more informed and non-stereotyped career choices are to be effected.

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Footnotes

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¹The expanded reports on the mathematics self-efficacy project, including more extensive descriptions of the instruments and procedures, are available from the author.

Table 1
Means, Standard Deviations and Zero-Order Correlations
of Variables Included in the Path Analysis

Variable	Mean	SD	1	2	3	4	5	6
1. Gender ^a								
2. BSRI Masculine score	4.85	.69	-.28***					
3. Years of high school math	4.05	.86	-.18*	.06				
4. ACT Math score	20.21	6.6	-.19*	-.01	.46***			
5. Mathematics self-efficacy	6.40	1.18	-.25**	.26**	.47***	.66***		
6. Math Anxiety	30.30	8.77	-.23**	.02	.33***	.47***	.58***	
7. Math-relatedness of declared major ^b	3.62	.85	-.37***	.10	.43***	.38***	.50***	.44***

Note: Total N=117; 72 females and 45 males.

^aGender was coded "0" for males, "1" for females.

^bMath/science-relatedness of major was coded on a continuum from "1" (Fine arts) to "5" (Physical sciences/mathematics).

* $p < .05$

** $p < .01$

*** $p < .001$

Table 2

Decomposition of the Effects from the Path Analysis Using the Reduced Model

	Zero-order Correlation	Causal Effects			Noncausal Covariation	R ²	
		Direct	Indirect	Total		Full Model	Reduced Model
Effects on masculine sex-role:							
of gender	-.277	-.277	.000	-.277	.000	.076	.076
Effects on years of high school math:							
of gender	-.180	-.180	.000	-.180	.000	.033	.032
Effects on ACT Math scores:							
of gender	-.193	-.115	-.078	-.193	.000	.226	.221
of years math	.457	.436	.000	.436	.021		
Effects on math self-efficacy:							
of masculine sex-role	.262	.259	.000	.259	.003	.541	.540
of years math	.472	.194	.251	.445	.027		
of ACT math	.661	.576	.000	.576	.085		
Effects on math anxiety:							
of gender	-.234	-.134	-.039	-.173	-.061	.380	.374
of masculine sex-role	.022	-.172	.154	-.018	.04		
of math self- efficacy	.583	.595	.000	.595	-.012		
Effects on math- relatedness of major:							
of gender	-.374	-.236	-.127	-.363	-.011	.379	.377
of years math	.429	.215	.152	.367	.062		
of math self-efficacy	.502	.244	.100	.344	.158		
of math anxiety	.437	.168	.000	.168	.269		

Figure Caption

Figure 1. Reduced Path Model.

